

BROOKHAVEN

NATIONAL LABORATORY

Building 460
P.O. Box 5000
Upton, NY 11973-5000
Phone 631 344-8627
Fax 631 344-2361
sheridan@bnl.gov

managed by Brookhaven Science Associates
for the U.S. Department of Energy

www.bnl.gov

April 2, 2003

Mr. Michael D. Holland
Manager, Brookhaven Area Office
U.S. Department of Energy
Building 464
Upton, NY 11973

Dear Mr. Holland:

**SUBJECT: Accelerator Readiness Review (ARR) Recommendation for Operation of
the NASA Space Radiation Laboratory (NSRL)**

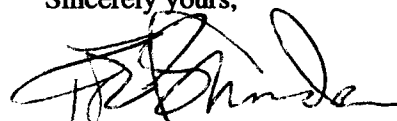
Attached for your review and approval is the ARR for the NSRL. This review was conducted in compliance with the provisions of DOE Order 420.2, *Safety of Accelerator Facilities*, and the BNL Accelerator Safety Subject Area.

We find that there are no open items and that NSRL is ready for Phase IIA commissioning.

Please indicate your authorization to operate by signing and returning the enclosed copy of this letter. Your timely response to this request will be greatly appreciated.

If you have questions, please contact Edward Lessard on Ext. 4250.

Sincerely yours,



Thomas R. Sheridan
Deputy Director, Operations

TRS/lim
Attachment

cc: M. Davis, w/o enclosures
H. Kahnhauser, w/o enclosures
P. Kelley, BAO, w/o enclosures
T. Monahan, w/o enclosures
E. Lessard, w/o enclosures ✓
D. Lowenstein, w/o enclosures
W.R. Casey, w/o enclosures

NASA Space Radiation Laboratory
(Formerly Called Booster Applications Facility)

Accelerator Readiness Review

Phase II Commissioning

March 31, 2003

I. Introduction

The Accelerator Readiness Review Team for the start-up of the Booster Applications Facility¹ was appointed by the Deputy Director for Operations on May 15, 2002. It was planned from the beginning to perform the review in three phases: 1) initial extraction from Booster and transport to the facility target room; 2) commissioning of the experimental program; and 3) routine operations.

A detailed review of the first phase of the commissioning process for this facility was conducted in the fall 2002. The report of this review was transmitted to the Deputy Director for Operations on September 16, 2002. Closure of all items was confirmed in a letter to the Deputy Director dated October 18, 2002. The reader is referred to those documents for additional details regarding the ARR process and the findings of the phase I review.

The ARR for the Phase II Commissioning of the NASA Space Radiation Laboratory (NSRL) started on March 24, 2003 with a presentation and discussion by Collider Accelerator Department personnel. A tour of the transport line, target room and support buildings was also included. During this opening presentation, CAD management requested that the Phase II commissioning be divided into two distinct parts. The scope of the Phase IIa commissioning is very similar to the activities of the Phase I commissioning conducted in Oct. 2002. Additional time is needed to complete all tests and evaluations planned for the first Phase. Phase IIb activities will consist of the set-up, testing and evaluation of the equipment and facilities associated with the research program. A more detailed breakdown of Phase IIa and Phase IIb activities is included in Attachment I.

II. Scope of Review

The ARR Team's charge for Phase IIa commissioning is to determine if CAD is prepared to safely extract a beam from the Booster ring and transport it to the beam stop at the rear of the target hall. It is understood that this commissioning phase includes a number of activities intended to define transport and extraction parameters required to deliver beam effectively from the Booster to the experimental hall. Another very important activity to be conducted during Phase IIa is the beam line fault study which is critical to determining that the shielding of the facility is adequate.

The charge for Phase IIb commissioning is to determine if CAD is prepared to safely set-up and test the apparatus and equipment within the target hall that will be used in the experimental program. This review also includes the continued installation, set-up and preparation of equipment within the support buildings in preparation for routine operation in the summer, 2003. It is expected that animals will be introduced into the building and that trial animal irradiations will be conducted during Phase IIb.

The scope of the Phase I review conducted last fall was extensive and included the following topics:

¹ The Booster Applications Facility was subsequently renamed the NASA Space Radiation Laboratory and will be referred by this name throughout the remainder of this report.

1. Adequacy of commissioning plan, including the fault study to be conducted during phase
2. Status of access control and interlock systems
3. Operational procedures
4. Status of training & qualification for new procedures
5. Status of SAD commitments for:
 - Shielding
 - Beam stop
 - critical devices
 - access control
 - radiation monitoring
 - fire protection systems
 - ground water protection
 - tunnel purge fan
 - Status of BORE and ORE findings

The scope of this ARR is less extensive and builds on the prior in-depth review. We examine only changes to previous topics or unreviewed issues relevant to this Phase II.

The ARR team reviewed the following topics:

- The “Commissioning and Acceptance Plan for Operation of the Booster Application Facility”, dated 2/15/02.
- The Fault Study Plan dated 10/17/02.
- The operational readiness of the downstream transport tunnel, the target hall, and the support building.
- Changes to the access control system.
- The status of items previously identified in CAD or ARR reviews
- Status of fire and ventilation systems in target hall and support building.
- Status of training and qualifications of personnel involved in Phase IIa and IIb commissioning.

ARR Team Members

The ARR team consisted of five members - their affiliation and primary areas of review are listed below.

Name	Affiliation	Primary Responsibility
R. Casey	NSLS Department	Phase IIa Commissioning activities and fault study
M. Davis	Environmental Services Division	Operational Readiness
T. Monahan	Safety & Health Services Division	Operational Readiness & Access Control Systems

S. Stein	Quality Programs & Services Office	Training & Status of Open Items
J. Wishart	Chemistry Department	Phase IIb Commissioning Activities

P. Kelley from the local Brookhaven Area Office of the DOE participated as a team member in the review and provided DOE oversight of the process and findings.

Guidance for the ARR process was provided by DOE Order 420.2 Safety of Accelerator Facilities; the draft Accelerator Safety Implementation Guide and the BNL SBMS Subject Area on Accelerator Safety. The individual reports of the ARR team members are included in attachment II.

III. Readiness Determination

The ARR team has determined that the CAD has conducted comprehensive reviews of the NSRL facility and has taken steps to incorporate all commitments made in the SAD into the facility and operational programs. Several issues identified in Section V are open at this time – therefore, the recommendation to approve the start of Phase IIa and IIb Commissioning awaits verification of closure of these items. The Team will monitor progress at the facility until all issues identified in this report have been verified, and will provide a follow-up letter to the Deputy Director at that time.

IV. Summary of topic areas reviewed by team

The Fault Study Plan for the Phase I Commissioning was approved last October by the RSC Chair. This plan will form the basis for the continuation of the fault study that will be conducted during the Phase IIa commissioning. This plan needs revisions to reflect the use of polarized protons during this commissioning period, rather than heavy ions.

A BAF commissioning plan entitled “Commissioning and Acceptance Plan for Operation of the Booster Application Facility”, dated 2/15/02 was reviewed. This document defines the program elements necessary for the commissioning of BAF. It is a comprehensive program plan but contains limited information about the actual activities to be performed during the Phase IIa or IIb commissioning phases. The ARR team believes that a plan defining the scope of work to be accomplished in Phase IIa and IIb is needed as a supplement to the Commissioning and Acceptance Plan mentioned above. A succinct outline of activities (<http://www.rhichome.bnl.gov/AGS/BAF/Commissioners/bafstartuptasks.html>) already exists for the CAD staff performing the commissioning. Together with the fault study plan, these tasks form the basis for a CAD document defining the scope of the Phase IIa commissioning activities. A similar document will be needed for Phase IIb activities.

The **access control system** was reviewed in detail during the phase I ARR. Since that period, CAD replaced the strobe lights and audible alarm which activate following “beam enable” with

a voice warning and a dimming of the facility lighting. The ARR review found that this modification received appropriate internal review.

Erosion of a portion of the berm above the NSRL transport line occurred during the winter. The potential impact of this condition has been reviewed by the CAD Radiation Safety Committee Chair and found to be acceptable to conduct commissioning activities. This location will be evaluated during the fault study, as well as another location with shielding thinner than specified in the SAD. Both locations are within the fenced area above the berm and are not anticipated to cause radiation exposure to personnel. These issues will be evaluated during the fault study.

Interlocked area monitoring is required for the NSRL facility and are in place for the Phase II commissioning. Five chipmunks are installed at the following locations.:

- On the berm above the target room
- In the labyrinth leading to the BAF laboratories
- In the labyrinth leading to the truck access
- 2 in the spur tunnel

During the Phase IIb Commissioning, **animals** will be introduced into the support building and target hall. This is an important transition that will require additional review and approvals. The ARR team determined that CAD will utilize the expertise of M. Kershaw, Manager of the Brookhaven Laboratory Animal Facility (BLAF), & member of the Institutional Animal Care and Use Committee (IACUC), to identify and implement testing/acceptance protocols for handling animals in the target rooms and support buildings. CAD plans to utilize the Experimental Safety Review process to establish a work plan for any testing/commissioning using animals or cells. This process is currently utilized for experiments at the AGS A3 beam line.

An **Operational Readiness Evaluation** of the transport tunnel, target hall and support buildings was conducted on March 26. All pre-start findings from this process must be resolved prior to commissioning. The ARR team walk-through identified 3 other items to be added to this list that will need to be completed before start of commissioning.

The testing and acceptance of the **ventilation and sprinkler systems** in the target hall and support buildings was evaluated and found in order. A recommendation was made to establish a process to ensure annual testing of the exhaust fans.

The Personnel Qualification Requirements for the operations staff involved in Phase IIa and IIb commissioning were reviewed and found to be complete. All staff have received the required training and are qualified to operate the facilities. The training that will be required for outside users of the NSRL has been developed and will be given at the appropriate time

The status of all items identified during CAD and previous ARR reviews that relate to Phase II commissioning were examined. All items related to Phase IIa were found closed. Several open items relating to Phase IIb commissioning remain to be completed.

One **environmental issue** that was a holdover from the Phase I review was discussed further. Following input from M. Kershaw, it was determined that the function of the drain covers in the animal rooms was to prevent infiltration of insects, and is not related to spill prevention. The CAD SAD was revised accordingly.

V. Recommendations

A number of recommendations are open at the time of this report. All items identified as pre-start will require verification by the ARR team prior to recommending approval to the Deputy Director for Operations.

Prior to Phase IIa Commissioning

The following documentation is required prior to commissioning.

1. Establish a work plan or procedure defining the range of approved activities that will be conducted during Phase IIa commissioning. (still under discussion)
2. Revise the fault study to reflect the operating conditions during this commissioning period (Closed)
3. Provide documentation of testing & acceptance of ventilation system. (closed)
4. Initiate an FATS action to develop a tickler card to prompt annual testing of the exhaust fans. (closed)
5. Provide waterproof electrical enclosures for the animal lab lighting timers (Closed, based on interim measures – will need to be tracked until water proofing accomplished)
6. Correct the exposed energized posts within the aforementioned enclosures (closed)
7. Provide adequate grounding path for the beam-line and components in the target hall. (closed)

Prior to Phase IIb Commissioning

1. Establish an approved work plan or procedure defining the scope of approved activities that will be conducted during Phase IIb commissioning. (Still under discussion)
2. Demonstrate closure of open issues related to this phase IIb currently tracked in family ATS. (Open)

Attachment I

NSRL ARR Scope of Review

The Accelerator Readiness Review of Phase II Commissioning for the NASA Space Radiation Laboratory (NSRL) will evaluate 2 separate phases as described below. It is anticipated that the recommendation concerning Phase IIa commissioning will be made on or about April 1 and that the recommendations for Phase IIb commissioning will be made on or about April 15.

Phase IIa - Transport extracted beam from Booster to final beam stop in target hall and conduct fault study. Included in this activity is the operation and testing of various beam diagnostic equipment required to define and control beam quality and characteristics. It is understood that the fault study will be conducted at the beginning of IIa commissioning and that the correction of any shielding issues identified by the study is required for the continuation of planned work. This activity may extend several weeks.

Phase IIb - Two distinct types of activities will be conducted during Phase IIb

- Set-up and evaluation of experimental detectors and other apparatus in the target hall associated with the experimental program. This activity will utilize extracted beam to establish performance characteristics and readiness of this equipment. In addition, toward the latter part of this commissioning period, trial animal irradiations will be conducted to verify readiness of equipment and the facility to conduct routine operations. This activity will be conducted over a several month period.
- Installation and set-up of equipment and other supplies within the support labs in Bldg. 958. This activity does not involve extracted beam, and consists of those steps needed to ensure that the facility is properly equipped to address programmatic and ESH requirements when the facility begins routine operation in the summer, 2003. This activity also includes the introduction and handling of animals as a part of the trial animal irradiations.

Review Topics

The issues that will be evaluated to determine the readiness for each activity are identified below. The person who will conduct the evaluation is noted in parenthesis.

Phase IIa Commissioning

- Review the approved fault study plan that has been developed. (Casey)
- Review the changes to the access control system. (Monahan)
- Review the results of operational readiness inspection of the downstream end of the transport line and the target room. (Monahan, Davis)

- Confirm that all previous items identified by CAD or ARR for phase 1 and 2 are closed. (Stein)
- Confirm testing and acceptance of fire and ventilation systems in target hall and support building. (Monahan)
- Review training and qualifications of personnel involved in this activity. (Stein)

Phase IIb Commissioning

- Review the results of the fault study conducted in Phase IIa. (Casey)
- Review the approved work plan for the activities associated with the experimental hall. (Wishart)
- Review training and qualifications of personnel involved in this activity. (Stein)
- Verify that there are established department processes to ensure conformance with BNL and outside agency requirements prior to the introduction of animals into the NSRL. (Monahan/Davis)
- Resolve issue regarding "floor drain covers in the animal rooms" (Davis)

Attachment II

Individual Team Member Reports

NSRF ARR Evaluation Form

Topic: Operational readiness of downstream end of transport line, target room and experimental areas

Date: 3/31/03

I. Evaluation Criteria : Define how you will verify the topic

Have the fire and ventilation systems been tested and accepted?

How will annual testing of Target Room and Support Building ventilation exhaust fans be administered?

Verify that there are established department processes to ensure conformance with BNL and outside agency requirements prior to the introduction of animals into the NSRL

The following issue remained open from the earlier ARR: The SAD identifies "floor drain covers in the animal rooms" as a specific pollution prevention design feature related to liquid effluents. The covers are not there, and their function as mentioned in the SAD is unknown.

II. Records Reviewed: List any records reviewed

The C-A ATS items documenting completion and acceptance of the fire/sprinkler systems on June 2, 2002 was reviewed.

III. Interview(s) Conducted: List interviews conducted

D. Passarello and E. Lessard were interviewed on 3/28/03.

IV. Sites Visited: Identify any areas that were inspected

The target hall, tunnel and experimental building were toured/inspected on 3/24/03.

V. Discussion of Results:

The C-A ATS item documenting completion and acceptance of the fire/sprinkler systems on June 2, 2002 was reviewed.

C-A will establish an FATS action to develop a tickler card to prompt annual testing of the exhaust fans.

C-A will utilize the expertise of M. Kershaw, Manager of the Brookhaven Laboratory Animal Facility (BLAF), & member of the Institutional Animal Care and Use Committee (IACUC), to identify and implement testing/acceptance protocols for the experimental equipment (animal and cell rooms in building 958).

C-A plans to utilize the Experimental Safety Review process to establish a work plan for any testing/commissioning using animals or cells. This process is currently utilized for AGS A3 experiments.

The animal room floor drain cover issue was resolved based on input from M. Kershaw. The SAD was revised accordingly.

VI. **Conclusion:**

Pending completion of the identified recommendations, C-A has achieved the level of readiness necessary to authorize commissioning of the beamline into the target hall, and commissioning of the experimental areas and equipment.

VII. **Recommendation**

The following documentation is required prior to commissioning.

1. Provide documentation of testing & acceptance of ventilation system.
2. Initiate an FATS action to develop a tickler card to prompt annual testing of the exhaust fans.

Reviewer: Mark C. Davis 3/31/03

ARR Evaluation Form

Topic: Fault Study Plan for NSRL Phase IIa Commissioning

Date: 3/31/03

I. Evaluation Criteria:

The fault study plan for the Phase IIa commissioning will be reviewed to determine completeness.

II. Records Reviewed:

The "BAF Fault Study Plan" dated Oct. 17th, 2002. [This plan was written by A. Rusek and approved by W. Glenn, acting chair of the CAD Radiation Safety Committee on Oct. 17th, 2002.]

III. Interview(s) Conducted:

Telephone discussion with Adam Rusek. Exchange of several emails with E. Lessard

IV. Sites Visited:

There was a walk-through of the NSRL facility on 3/24/03.

V. Discussion of Results:

The previously approved fault study plan was a comprehensive discussion of the fault conditions to be studied and the methods for creating them. It also defined the locations that must be surveyed and the radiation levels that are expected during a heavy ion run based on the calculations included in the SAD. This fault study plan is excellent, but needs to be updated to reflect the running conditions associated with this commissioning period (namely protons rather than heavy ions)

The NSRL commissioning plan entitled "Commissioning and Acceptance Plan for Operation of the Booster Application Facility", dated 2/15/02, has also been prepared and approved by CAD management. This document defines the program elements necessary for the commissioning of NSRL. It is a comprehensive program plan but contains limited information about the actual activities to be performed during the Phase IIa or IIb commissioning phases. The ARR team believes that a plan defining the scope of work to be accomplished in Phase IIa and IIb is needed as a supplement to the Commissioning and Acceptance Plan mentioned above. A succinct outline of activities (<http://www.rhichome.bnl.gov/AGS/BAF/Commissioners/bafstartuptasks.html>) already exists for the CAD staff performing the commissioning. Together with the fault study plan, these tasks form the basis for a CAD document defining the

scope of the Phase IIa commissioning activities. A similar document will be needed for Phase IIb activities.

Erosion of a portion of the berm above the NSRL transport line occurred during the Winter. The potential impact of this condition has been reviewed by the CAD Radiation Safety Committee Chair and found to be acceptable to conduct commissioning activities. This location will be evaluated during the fault study, as well as another location with shielding thinner than specified in the SAD. Both locations are within the fenced area above the berm and are not anticipated to cause radiation exposure to personnel. .

VI. **Conclusion:**

Following completion of an approved procedure defining the scope of Phase IIa commissioning, the CAD will be better prepared to initiate the next round of commissioning.

VII. **Recommendation**

Establish an approved procedure encompassing the range of activities, including the fault plan that will be conducted during Phase IIa commissioning.

Reviewer: W. R. Casey

**Accelerator Readiness Review (ARR) Evaluation Form
For
NASA Space Radiation Laboratory (NSRL)**

Topic: Training

Date: 3/28/03

I. Evaluation Criteria:

This topic reviews how the Collider Accelerator Department (C-AD) assures training of personnel. All training of personnel required for Phase 1 and 2 are to be reviewed. The topic will be assessed by conducting interviews and document reviews.

II. Documents & Records Reviewed:

Job Training Assessment (JTA) GE-77K – C-A Radiobiology User
C-A Radiobiology Users Training Study Guide (Dated Sept. 2002, rev 00)
The following action items in the C-AD family ATS, concerning training:

1127.1.12

1127.2.12

1127.3.10

Copies of these action items (as of 3/27/03) are attached.

Training Records for: Nicholas Luciano; Joseph Glenn, III

III. Interview(s) Conducted:

J. Maraviglia – Training (3/27/03)

IV. Sites Visited:

C-AD staff gave a tour of Bldgs. B956 and B958 on Mar. 24, 2003.

V. Discussion of Results:

ATS action items 127.1.12 and 1127.2.12 indicated that training for appropriate personnel in the following groups has been completed: Main Control Room (MCR) Operators; Main Control Room (MCR) Operations Coordinators; Collider-Accelerator Support (CAS) Watch personnel; Liaison or Accelerator Physicists. A check of training records for two staff members, from two of these groups, verified that it was completed.

Thus, all staff have received the required training and are qualified to operate the facilities. The training that will be required for outside users of the NSRL has been developed and will be given at the appropriate time (See action item number 1127.3.10)

VI. Conclusion:

C-AD has completed all the training of personnel involved with Module 2 and can proceed with respect to this topic.

VII. Recommendation

There should be follow-up that training of outside users is reviewed by the ARR team at the appropriate time.

Reviewer: Steven Stein

**Accelerator Readiness Review (ARR) Evaluation Form
For
NASA Space Radiation Laboratory (NSRL)**

Topic: Action Tracking System (ATS)

Date: 3/28/03

I. Evaluation Criteria:

This topic reviews how the Collider Accelerator Department (C-AD) tracks their commitments using the C-AD family ATS (<http://ats.bnl.gov/>). All assessments and associated action items identified by C-AD or the ARR for Phase 1 and 2 are to be reviewed to verify their current status. The topic will be assessed by conducting interviews and document reviews.

II. Documents & Records Reviewed:

Actions items from the following ATS entries were reviewed:

524

790

920

1114

1127

1351

Copies of these ATS numbers (as of 3/27/03) are attached.

III. Interview(s) Conducted:

D. Passarello – Quality Assurance (3/27/03)

IV. Sites Visited:

C-AD staff gave a tour of Bldgs. B956 and B958 on Mar. 24, 2003.

V. Discussion of Results:

A review of the all the assessment action items (refer to Section II) indicated that they are either closed or open (but not overdue). Those open action items are either:

- related to Phase IIB or
- must be completed prior to operations, e.g. 524.1.7, Add LOTO fan switch ‘on’ to checklist, or
- are not required for operation and will be completed by the required date, e.g. 920.3.8, Use of photographic chemicals

VI. Conclusion:

C-AD has completed all the items needed to conduct Module 2 and those items associated with the initial Phase 1 ARR (see Report dated Sept. 1, 2002).

VII. Recommendation

C-AD can proceed with Module IIa with respect to having completed all the required actions items at this time. All open items concerning Modules IIB are to be reviewed by the ARR team at the appropriate time

Reviewer: Steven Stein

ARR Evaluation Form for NSRL

Topic: Operational Readiness of transport line, target room & experimental areas

Date: 3/31/03

I. Evaluation Criteria: Define how you will verify the topic

Review changes to the access control system.

Ensure closure of all appropriate internal ES&H committee findings.

Ensure acceptance testing for the fire and ventilation systems.

Verify organizational mechanisms to conform to both BNL Institutional Animal Care & Use Committee (IACUC) requirements and the USDA requirements.

II. Records Reviewed: List any records reviewed

The C-A-ATS documented Internal CA ES&H Committee (ESRC, RSC & ASSRC) review of the NSRL. C-A-ATS assessments for the NSRL are numbered 524, 790, 920, 1114, 1127 & 1351.

The C-A ATS documented completion and acceptance of the fire/sprinkler systems on June 2, 2002 was reviewed.

III. Interview(s) Conducted: List interviews conducted

D. Passarello and E. Lessard were interviewed on 3/28/03.

IV. Sites Visited: Identify any areas that were inspected

The target hall, tunnel and experimental building were toured/inspected on 3/24/03.

V. Discussion of Results:

C-A department has discovered that the original access control system design with strobes and alarm for beam enable was unsettling for the animals used in research. As a result they have replaced the alarm with a voice warning of beam enable status. The strobe light has been replaced with a dimming of the facility lighting. **NOTE: Emergency lighting still provides adequate illumination for egress.**

The C-A ATS was evaluated during the interview listed above. All appropriate findings are being addressed and being closed. There was

however some concern with regard to several issues identified during the 3/24/03 orientation of the NSRL facilities. These items were added to the C-A-ATS. Three issues identified that require immediate attention were: 1) providing waterproof electrical enclosures for the animal lab lighting timers; 2) addressing the exposed energized posts within the aforementioned enclosures; and 3) ensuring adequate grounding path for the beam-line and components in the target hall.

Acceptance testing and periodic maintenance of the fire detection/prevention systems and ventilation systems are covered under report from M. Davis.

C-A will utilize the expertise of M. Kershaw, Manager of the Brookhaven Laboratory Animal Facility (BLAF), & member of the Institutional Animal Care and Use Committee (IACUC), to identify and implement testing/acceptance protocols for the experimental equipment and treatment of animals in the NSRL.

C-A plans to utilize the Experimental Safety Review process to establish a work plan for any testing/commissioning using animals or cells

VI. **Conclusion:**

With closure of the three issues below I believe the NSRL is ready to begin module 2 of commissioning of the NSRL facility as identified in 3/24/03 presentation.

- 1) Providing waterproof electrical enclosures for the animal lab lighting timers;
- 2) Addressing the exposed energized posts within the aforementioned enclosures; and
- 3) Ensuring adequate grounding path for the beam-line and components in the target hall.

VII. **Recommendation**

Ensure closure of the three findings documented in the conclusion section of this report.

Reviewer: Terry Monahan